

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts

LUMINARY Memo #52

To: Distribution
From: C. Schulenberg
Date: 3 November 1968
Subject: LUMINARY Revisions 54-60

Major Changes Incorporated into Revision 56

Note: Revision 56 was made to fix serious problems encountered in Revs. 54 and 55.

- 1) A program error was fixed in the 2PHSCHNG routine that had been introduced in Rev. 53.
- 2) The P70/P71 restart protection was thoroughly revamped especially in the area of coding that proceeds to P40 or P42.
- 3) A necessary call to ZATTEROR (to zero the DAP attitude errors) was added to the Ascent guidance prior to the point where the dead-band is changed to .3 degrees for RCS trimming.
- 4) DVMON was restart-protected in order to prevent multiple decrements of DVCNTR.
- 5) The POODOO routine was changed to examine V37FLAG rather than AVEGFLAG in its determination of whether or not Servicer was still in operation (if AVEGFLAG = 0 and V37FLAG = 1 then AVETOMID is in progress).
- 6) The remainder of PCR 539 was implemented by addition of coding to the DAP which checks the SNUFFER flag (set and reset by Verbs 65 and 75, respectively).
- 7) The check on the value of TIME5 was deleted from the T5RUPT lead-in (Colossus relic).
- 8) PCR 140 was implemented (Uprated Rate Command Attitude Hold).
- 9) The values of the thresholds used by DVMON were changed in accordance with PCR 612.2.
- 10) P12, P70 and P71 were modified to use the same fixed memory tailoff times as P40 and P42.

- 11) All checking of the COMPUTER flag was removed from LUMINARY. The flagbit still exists, and is reset by Fresh Start, but it is now totally unused, being retained only for edit programs.
- 12) Coding was added to P63 to set the R04FLAG, which prevents R12 from issuing alarm 521, and the NORRMON flag, which insures that R25 does not run with R10.
- 13) PCR 568 was implemented by removing the resetting of the NOR29FLG from P63. R29 will not operate during the landing unless P70 or P71 are used.
- 14) An unnecessary extrapolation of the CSM state vectors was deleted from the landing-site IMU orientation determination routine - an angular momentum vector is invariant.
- 15) PCR 551 was implemented (Rotational Hand Controller Scaling).
- 16) VHFRFLAG was deleted since it is a Colossus-only flagbit.
- 17) A program error was corrected in the radial-control equations of the one-phase Descent guidance equations.
- 18) Coding was added to V37 to insure that R04FLAG is reset.

Major Changes Incorporated into Revision 58

- 1) Some incorrect scale factors associated with PCR 551 were corrected in R03 and Fresh Start.
- 2) A bug was corrected in the DAP that had resulted in the bypassing of the Q and R-axis attitude errors when the DAP was in the auto mode. The error calculations should have been bypassed in the manual mode but the check on bit 13 of channel 31 was reversed.
- 3) The P40/P42 Time-to-go calculator routine was modified to use either the true APS or DPS exhaust velocity rather than a single mean value.
- 4) An R05 priority problem was corrected. Keying in a V34E to the flashing V06N51 did not terminate the program quickly enough.
- 5) Fresh Start was modified to initialize DUMPCNT to octal 04000. DUMPCNT, heretofore nowhere initialized, is examined by the Verb 74 routine to determine how many times erasable memory is to be transmitted via downlink. The number loaded by fresh start will give one pass.
- 6) The 1210 alarm was changed from a POODOO to a BAILOUT since the cause of the stall conflict would most likely be an extended verb which a software restart would flush.
- 7) R12 was modified in order to make VMEAS and VSELECT a consistent set for the Downlink.
- 8) Some minor GTS-related coding, which had been lost in the process of incorporating PCR 140, was reinserted into the DAP.

- 9) The DPS and APS engine tail-off times were updated in accordance with PCR 587. 2.
- 10) R25 was modified to skip its checks if both AVEGFLAG and MUNFLAG were set, rather than by examining the NOR29FLG. This was necessitated partly by PCR 568 which had been previously implemented. The result of this is that R25 will run in the landing until TIG -30 and then resume at selection of P68, and in the ascent (P12) until TIG -30, resuming at P12 termination.

Major Changes Incorporated into Revision 60

- 1) PCR 604 was implemented.
- 2) PCR 608 was implemented.
- 3) The gravity-determination routine of P57 was rewritten to insure regular pipa readings and correct IMU drift compensation.
- 4) Coding was added to R59 to bypass the star-acquisition sequence if the AGC had no REFSMMAT.
- 5) PCR 609 was implemented in S40. 2, 3.
- 6) The computation of the XNBPIP matrix in Servicer was protected from interruption by R12 by raising its priority to 24 initially and then lowering it to 20 upon completion.
- 7) PCR 615 was implemented (Extension of R04).
- 8) PCR 614 was implemented (Addition oof Noun 38).
- 9) Coding was changed in AOTMARK to set the star-vector along the optics axis if both YROT and SROT were zero.
- 10) Coding was added to Fresh Start and Restart to cause any ensuing T6RUPT to disable subsequent T6RUPTs by disabling the TIME6 counter.
- 11) PCR 617 was implemented and the R29/R10 interface logic was removed. A new flagword R10FLAG was defined as part of this change. When P70, P71 or P12 set R10FLAG, R10 ceases to output data to the cross-pointer.
- 12) PCR 576. 2 was implemented (Removal of Backward Updating Constraint on State Vectors).
- 13) The locations of RADMODES and DAPBOOLS were altered so that these are now true flagwords, namely, FLGWRD12 and FLGWRD13 respectively.
- 14) All LUMINARY fixed-memory constants relating to either APS or DPS thrust mass-flow-rate, or ISP were updated according to the latest available information. The numbers were coordinated with the values in the pending release of Section 5 of the GSOP.

- 15) Coding was added to READACCS to check, and if necessary adjust, the value of TIME5 so that the DAP T5RUPTS are forced into a particular synchronization with respect to Readaccs and the R10/R11 tasks - namely so that a T5RUPT occurs approximately 70 milliseconds following a Readaccs rupt. This was done to minimize the possibility of losing Downrupts. Every twentieth PAXIS rupt is advanced or delayed by 10 milliseconds until Synchronization is achieved.
- 16) PCR 561 was implemented.
- 17) The implementation of PCR 133 was completed, finally. In addition to TBRKPNT there are now two additional pad-loads for P70 and P71, namely, ABTVINJ1 and ABTVINJ2. These are the desired injection velocities when TFI is less than, or greater than, TBRKPNT.
- 18) PCR 613 was implemented.
- 19) A program error was corrected in the Ignition routine common to all burn programs. Prior to this fix an engine failure, followed by a recycle to TIG -5 (by a proceed to the flashing V97), followed by a relight (by a proceed to the flashing V99), would leave the deadband during the subsequent burn at either .3 degrees or 5 degrees - but not the normal 1 degree.
- 20) The setting of NORRMON in P63 was deleted since the same function was achieved by coding recently added to R25 itself.
- 21) Coding was added to Servicer to insure that PUSHLOC, FIXLOC, and OVFIND were properly initialized before proceeding to the guidance equations.
- 22) Verb 35 was modified to light the two new DSKY lights serviced by R12.
- 23) The Rendezvous Radar designate gain was reduced from 1 to .707 in order to avoid instabilities, and a resulting 503 alarm, when designating with large errors and high line-of-sight rates.
- 24) PCR 589 was implemented.
- 25) Coding was added to P70 and P71 to set the R60 maneuver rate to 10 degrees per second prior to passing control to P40 or P42.